THE EFFECT OF INSTRUCTIONAL CONGRUENCE ON STUDENTS' INTEREST TOWARDS LEARNING SCIENCE

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Abstract

The research examined the effect of a teaching strategy emphasizing on instructional congruence on students' interests towards learning science. This study was conducted in three "low performing" secondary schools in Penang, Malaysia. There were 214 students involved in this study. A questionnaire was utilized to collect data on students' interest towards science. Data were analyzed using t-test. In general, findings showed that the implementation of this teaching strategy revealed a significant increase in students' interest towards learning science.

Keywords: Instructional congruence, funds of knowledge, interests towards learning science

Introduction

Education in Malaysia, as stated in the National Philosophy of Education (FPK), is a continuous effort to develop the potential of individuals in a holistic and integrated manner to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious, based on the belief and devotion to God. Parallel to the FPK, the National Philosophy of Science Education is to make science education in Malaysia as an effort to cultivate the culture of science and technology, on the development of competitive, dynamic, skillful and resilience of the people as well as their development of knowledge in science and technology. Science education is to make people not only balanced and harmonious in terms of physical, emotional, spiritual, and intellectual aspects, but also their contribution to the welfare of self, community, and country.

The learning of science should be implemented in the context of students' culture and experiences (Barton, 2001; Basu & Barton, 2007). In fact, teachers are rarely integrating the concept of science with students' experiences (Fusco, 2001). Meanwhile, researchers found out that there is a "connection" between learning science and students' experiences brought into classroom (Upadhyay, 2006; Basu & Barton, 2007; Lee et al., 2007). Thus, in establishing the process of learning science which is more relevant to students, teachers need to establish the learning environment that facilitate students to connect their experiences with science concepts being learned so that their interests towards science will be sustained.

The use of students' culture as a relevant source and strategies of teaching and learning is expected to make the teaching of science more interesting and meaningful to students. This is particularly so because of the differences of students' funds of knowledge. The ways students see and evaluate their funds of knowledge is different and depend on the type of experiences obtained from cultural environment respectively. This factor affect how students understand science concepts because of their funds of knowledge brought together in connection with students during learning science in classroom (Driver et al., 1994). Using students' funds of knowledge in teaching science not only help students to connect science concepts being learned with their experiences, but also could create the learning of science is more relevant and meaningful to students (Lee et al. , 2007; Luykx et al., 2004; Lee & Fradd, 2001). Incorporating students' funds of knowledge into teaching science could be best implemented through instructional congruence strategy.

Instructional Congruence

Instructional congruence is the process of mediating the nature of academic content with students' language and cultural experiences (Lee, et al., 2007; Johnson, 2005; Luykx, et al., 2004; Lee & Fradd, 2001). In this case, the cultural experience is the knowledge that students have obtained from their community, whereas students' language experiences are the language used in their daily life (Lee, 2004; Lee & Fradd, 1998). Instructional congruence allows science teachers identify knowledge of household and community that brought together with students during their learning in classroom (Luykx & Lee, 2005). When the knowledge of science incorporates with students' language and experiences, students will be more engage in the learning process and science will be easier, meaningful, and relevant to students. In addition, the instructional congruence also makes students understand the concept and the idea of science as a whole, as well as to master their inquiry skills and increase communication between students. Learning environment that put emphasis on instructional congruence could make students become a "bicultural, bilingual and biliterate" person not only in terms of knowledge, values and practice in science, but also in aspects of their language and culture (Luykx & Lee, 2005).

There are four main characteristics of instructional congruence. First, the role of teachers in the teaching process (Lee & Fradd, 2001), the instructions provide an emphasis on teacher's assessment and approach to meet the students' needs, and using the students' language and funds of knowledge in learning science (Lee & Fradd, 2001; Johnson, 2005). Teacher identifies what students need; their culture and their daily language used by students in order for teachers to ensure that their teaching is relevant to the students. This aspect could be found out through a formal discussion with the student, or an informal home visit. Students' funds of knowledge and language that have been identified need to be integrated in the design instruction. Communicating language and funds of knowledge between teachers and students is important because this can actively encourage students' engagement in the learning process.

Second, instructional congruence is a subject-specific pedagogy of teaching model based on particular cultural pattern. In learning science, this model emphasis on congruence between scientific knowledge and the inquiry process, with students' language and cultural experience (Lee & Fradd, 2001). Therefore, teachers need to give the similar emphasis between scientific knowledge and the actual inquiry process with students' language and culture experiences (Johnson, 2005). Moreover, teachers is expected to teach science in the context which allows students to create connections between their language and culture with the scientific culture and language so that the science content will easily be understood, meaningful and relevant to students (Lee & Fradd, 1998; 2004). The content of science is more easily understood if the teacher uses examples that are familiar with students, and deliver the content using language that congruence with students' language.

Third, in instructional congruence, learning science and language literacy of students are simultaneously applied and connected of each other. Students use language in talking science (Zurida & Hashimah, 2004), thus language literacy is required for talking science (Lee & Fradd, 1998; 2004, Luykx & Lee, 2007). In learning science, students' language literacy development is facilitated using various language formats such as oral, writing, drawing, table, and graph during presenting their idea of science. Learning science and language literacy can simultaneously improve students' mastery of writing skills on science, encourage more discussion, and allow more sharing on cultural experience (Johnson, 2005). Mutual relationship between learning science and language literacy promotes the development of language literacy that could be improved in the context of learning science. In this case, science teachers could play a role as a teacher for learning language literacy (Johnson, 2005).

Fourth, the concept of instructional congruence is constructivist approach, where learning is seen as an active process; students develop knowledge by integrating their experiences with environment. In instructional congruence, students' funds of knowledge and language are considered not only as valuable, but also could be used as resources in constructing and improving their knowledge and also in mastering inquiry skills (Fradd et al., 2002; Cuevas, et al., 2005; Lee et al., 2006). It also promotes their academic achievement in science and literacy (Fradd et al., 2002; Lee, 2002; Lee et al., 2006). Thus, the role of teachers is to ensure using their funds of knowledge and language that are relevant, to interact with their environment, and to relate science with their funds of knowledge and environment respectively. In instructional congruence, teachers' role is not to provide information but to facilitate students in helping them to develop their knowledge.

The teaching process based on instructional congruence also emphasizes scientific values and attitudes in learning science, such as curiosity, interest, honesty, open and critical mind, reasoning, argumentation, questioning, open criticism, and showing evidences rather than depend on the authority (Lee & Fradd, 1998). According to Lee and Fradd (1998), scientific values and attitudes such as curiosity, interest, and honesty might be found in most culture, whereas open and critical mind, reasoning, argumentation, questioning, open criticism, and less depending on the authority might be found in western science.

In the process of teaching based on instructional congruence, scientific views and students' alternative framework of science are considered. Students' scientific views on phenomenon involve a complex interaction between students' belief, scientific understanding, and cultural backgrounds. Thus, students' explanation of the observed phenomenon might also be different according to cultural backgrounds of students. Some students tend to use various instruments and scientific methods in their explanation, whereas there are also students who tended to use their alternative framework that involve their experience and the role of God as the power in providing their explanations. During introducing the scientific view to students, teachers also need to appreciate and integrate students' alternative framework (Lee & Fradd, 1998).

Context of the Study

Sample

This aim of this study was to find out the effect of teaching science based on instructional congruence on students' interests towards learning science. There were 214 students from Form 2 and Form 4 and 6 science teachers in three "low performing" secondary schools in Penang involved in this study.

Teacher Training

There were four series of workshops in the form of professional development teacher training carried out in this study. These workshops were aimed to introduce the concept of instructional congruence in teaching science in order to help teachers to deliver their lesson based on instructional congruence. Teachers continuously implemented the instructional congruence strategy during this study. The improvement and problem faced during implementation were discussed through out this series of workshops. The first workshop emphasized on introduction to the concept of instructional congruence in teaching science and discussion of incorporating students' funds of knowledge in teaching science. The sample of lesson plan based on this strategy was also provided and discussed. The second workshop was focused on the discussion on the concept of lesson plan and students' activities relevant to instructional congruence strategy. The third workshop discussed the lesson plan produced by teachers and their teaching experiences during implementation. The fourth workshop focused on various students' activities that carried our by teacher during implementation and sharing experiences. In each workshop, discussion and sharing of ideas among teachers and between teacher and researchers were as an important aspect. Suggestions identified during the workshops were highlighted for further improvement of the following teaching practices.

Instruments

The "Attitudes in Science" questionnaire, developed by Barmby, Kind, & Jones (2008), was used in this study. There were 37 items in the questionnaire, which consists of seven constructs representing the overall students' interest towards learning science (See Appendix for a detailed list). These seven constructs were learning science in school, self-concept in science, practical work in science, science outside of school, future participation in science, importance of science, and combined interest in science. The combined interest in science consists of the aspect of learning science in school and science outside of school. This questionnaire was pilot tested to 70 students. The Cronbach's alpha coefficients of each construct were more than 0.7 and for the whole instrument was 0.94. This pilot test result showed the instrument is reliable.

Data Collection and Analysis

Questionnaire was administered before (pretest) and after (posttest) the implementation of instructional congruence into learning science in three schools involved in this study. This data collection was facilitated by teachers. Analysis of mean differences on students' interest using t-test was conducted to find out the significance differences on students' interests during this study. Table 1 shows the result of t-test analysis.

Table 1: Analysis of student interest in science

Variables	*N*	*Pre test*		*Post test*		*t*	*df*	*sig*
		Mean	**SD**	**Mean**	**SD**			
Learning science in school	214	2.783	.555	2.854	.626	1.328	213	.186
Self-concept in science	214	2.398	.436	2.477	.453	1.865	213	.064
Practical work in science	214	2.728	.556	2.887	.622	2.786	213	.006
Science outside of school	214	2.671	.634	2.813	.618	2.406	213	.017
Future participation in science	214	2.507	.688	2.642	.700	2.000	213	.047
The importance of science	214	3.001	.655	3.077	.631	1.208	213	.228
Combined interest in science	214	2.662	.552	2.777	.577	2.182	213	.030
Overall interest in science	214	2.679	.486	2.785	.487	2.304	213	.022

Paired t-tests conducted to analyze whether there were significant differences in students' attitudes and interests before and after implementation of teaching with instructional congruence. Table 1 shows the results of the paired t-test analysis. The results of this analysis shows that the mean differences before and after the implementation of instructional congruence are statistically significant in constructs of practical work of science [t (213) = 2.786, p <0.05], science outside of school [t (213) = 2.406, p <0.05], future participation in science [t (213) = 2.000, p <0.05], combined interest in science [t (213) = 2.182, p <0.05], and overall attitudes in science [t (213) = 2.304, p <0.05]. The increasing value of mean scores in these constructs (with a significance level of p=0.05) shows that implementing instructional congruence in teaching science had a significant positive effect on the constructs mentioned above.

Conclusion

This study has shown that implementation of instructional congruence in teaching science has the significant effect in improving students' interest towards science, especially in the aspects of practical work of science, science outside of school, future participation in science, a combined interest in science and overall interest in science. In this case, the increase in students' interest in science during the implementation might be due to the increase of their capacity and effort to integrate their cultural experiences with science concepts being learned in the classroom.

This is particularly so due to implementing instructional congruence that promotes students' engagement in hands-on that put emphasis on the connection between students' funds of knowledge and science concepts. By "connecting" students' funds of knowledge with science, science is easier to understand, meaningful and relevant to their daily lives (Luykx & Lee, 2005). In this case, the learning process that put emphasis on instructional congruence helps students to make connection between science and their funds of knowledge (Lee & Fradd, 1998; Luykx & Lee, 2007). This condition allows students propose their scientific explanation based on objects they found in their own environment.

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Appendix

Response Options for Measures of Attitudes toward Science

Attitude measure	Item No.	Items comprising the measure
Learning science in school	Item 1	We learn interesting things in science lessons.
	Item 2	I look forward to my science lessons.
	Item 3	Science lessons are exciting.
	Item 4	I would like to do more science in school.
	Item 5	I like science better than most other subjects in school.
	Item 6	Science is boring.
Self-concept in science	Item 7	I find science difficult.
	Item 8	I am just not good at science.
	Item 9	I get good marks in science.
	Item 10	I learn science quickly.
	Item 11	Science is one of my best subjects.
	Item 12	I feel helpless when doing science.
	Item 13	In my science class, I understand everything.
Practical work in science	Item 14	Practical work in science is exciting.
	Item 15	I like practical work in science because you don't know what will happen.
	Item 16	Practical work in science is good because I can work with my friends.
	Item 17	I like practical work in science because I can decide what to do myself.
	Item 18	I would like more work that is practical in my science lessons.
	Item 19	We learn science better when we do practical work.
	Item 20	I look forward to doing science practices.
	Item 21	Practical work in science is boring.
Science outside of school	Item 22	I would like to join a science club.
	Item 23	I like watching science programme on TV.
	Item 24	I like to visit science museums.
	Item 25	I would like to do more science activities outside of school.
	Item 26	I like reading science magazines and books.
	Item 27	It is exciting to learn about new things happening in science.
Future participation in science	Item 28	I would like to study more science in the future.
	Item 29	I would like to study science at university.
	Item 30	I would like to have a job working with science.
	Item 31	I would like to become a science teacher.
	Item 32	I would like to become a scientist.
Importance of science	Item 33	Science and technology are important for society.
	Item 34	Science and technology make our lives easier and more comfortable.
	Item 35	The benefits of science are greater than the harmful effects.
	Item 36	Science and technology are helping the poor.
	Item 37	There are many exciting things happening in science and technology.
Combined interest in science		(Items from Learning science in school, Science outside of school, and Future participation in science combined)